

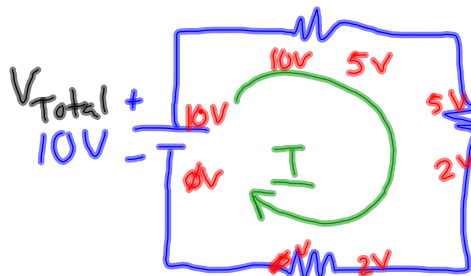
Circuits Continued:

• Series Circuits:

- Current is the same in all parts
- Resistors reduce voltage; batteries "produce" voltage

• Example: $V_1 = 5V$
 $R_1 = 5\Omega$

$$\begin{aligned} V_1 &= IR_1 \\ &= (1A)(5\Omega) \\ &= 5V \end{aligned}$$



$$R_2 = 3\Omega$$

$$\begin{aligned} V_2 &= IR_2 \\ &= (1A)(3\Omega) \\ &= 3V \end{aligned}$$

$$R_3 = 2\Omega$$

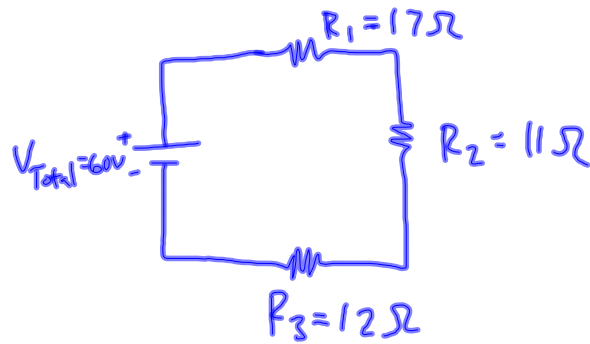
$$V_3 = IR_3 = (1A)(2\Omega) = 2V$$

$$\begin{aligned} R_{Total} &= R_1 + R_2 + R_3 \\ &= 5\Omega + 3\Omega + 2\Omega \\ &= 10\Omega \end{aligned}$$

$$V_{Total} = IR_{Total}$$

$$I = \frac{V_{Total}}{R_{Total}} = \frac{10V}{10\Omega} = 1A$$

• Another Example:



$$\begin{aligned} R_{\text{Total}} &= R_1 + R_2 + R_3 \\ &= 17\Omega + 11\Omega + 12\Omega \\ &= 40\Omega \end{aligned}$$

$$V_{\text{Total}} = I R_{\text{Total}}$$

$$I = \frac{V_{\text{Total}}}{R_{\text{Total}}} = \frac{60\text{V}}{40\Omega} = 1.5\text{A}$$

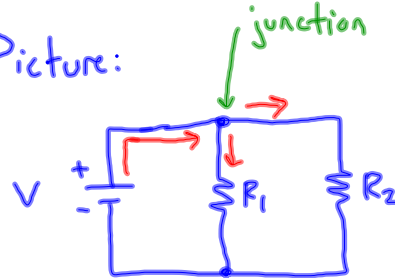
$$\begin{aligned} V_1 &= I R_1 \\ &= (1.5\text{A})(17\Omega) \\ &= 25.5\text{V} \rightarrow \text{voltage across the resistor (voltage drop)} \end{aligned}$$

$$\begin{aligned} V_2 &= I R_2 \\ &= (1.5\text{A})(11\Omega) \\ &= 16.5\text{V} \end{aligned}$$

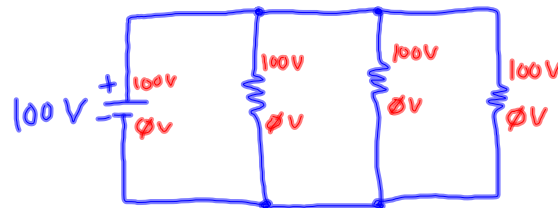
$$\begin{aligned} V_3 &= I R_3 \\ &= (1.5\text{A})(12\Omega) \\ &= 18\text{V} \end{aligned}$$

• Parallel Circuits:

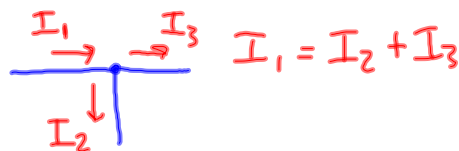
- There is more than one pathway for circuit to follow
- We call the pathways "branches"
- Picture:



- When one part of parallel circuit is disconnected, the rest of the circuit still works
- Voltage is the SAME in each branch

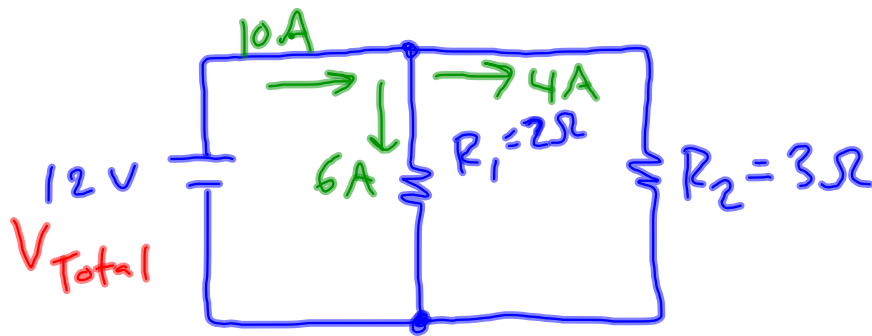


- Current can be different in each branch
- Current going into a junction must be the same as the current leaving a junction



• Example #3:

- Draw a parallel circuit with 2Ω and 3Ω resistors (each on its own branch) with a $12V$ battery
- Find current through each branch



$$V_{total} = I_1 R_1$$

$$I_1 = \frac{V_{Total}}{R_1}$$

$$= \frac{12V}{2\Omega}$$

$$= 6A$$

$$V_{Total} = I_2 R_2$$

$$I_2 = \frac{V_{Total}}{R_2}$$

$$= \frac{12V}{3\Omega}$$

$$= 4A$$

- Safety:

- When many things are added to a circuit, the overall resistance is lowered.
- This causes more current to flow, which increases the risk for fire
- Circuit breakers → essentially a magnetic switch that will open when the current is too high
- Fuse → wire ribbon that melts if the current is too high
- Fuses and circuit breakers open the circuit to prevent damage to anything that is attached